DOCUMENT RESUME

ED 223 905 CE 034 545

TITLE	Construction Mechanic, Engine Tune-Up II (Diesel), 8-8. Military Curriculum Materials for Vocational and Technical Education.
INSTITUTION	Naval Construction Training Center, Port Hueneme, Calif.; Ohio State Univ., Columbus. National Center for Research in Vocational Education.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
PUB DATE	78
NOTE	154p.; For related documents, see CE 034 542-544.
PUB TYPE	Guides - Classroom Use - Materials (For Learner) (051) -- Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	Audiovisual Aids; *Auto Mechanics; Course Content; *Diesel Engines; Educational Resources; *Engines; Hand Tools; Learning Activities; Lesson Plans; *Mechanics (Process); *Motor Vehicles; Postsecondary Education; Power Technology; Secondary Education; Technical Education; *Units of Study; Vocational Education
IDENTIFIERS	Automotive Fuel Systems; *Automotive Tune Up; Military Curriculum Project

ABSTRACT

This course, adapted from military curriculum materials for vocational and technical education, teaches students to restore diesel engine performance to the manufacturer's specifications through troubleshooting and analyzing diesel engine fuel systems and to make minor and major adjustments to those components that directly affect engine performance. Students will learn to use appropriate hand tools, special tools, and shop equipment to test, adjust, and replace fuel system components that fail to meet the manufacturer's specifications. The course consists of two units with one lesson in each, making up 56 hours of classroom and shop instruction. Unit 1 covers introductory material and safety precautions, while unit 2 focuses on engine tune-up. The course consists of a single document containing both student and teacher materials. Instructor materials provided are an introduction to the course; an outline of training objectives; lists of texts, references, tools, equipment, training devices, and training aids equipment; a master schedule; and lesson plans. The lesson plans contain an outline of instruction and activities for teachers and students. Student materials provided include three job sheets and one information sheet. (KC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED223905

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

L Foster

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

MILITARY CURRICULUM MATERIALS

The military-developed curriculum materials in this course package were selected by the National Center for Research in Vocational Education Military Curriculum Project for dissemination to the six regional Curriculum Coordination Centers and other instructional materials agencies. The purpose of disseminating these courses was to make curriculum materials developed by the military more accessible to vocational educators in the civilian setting.

The course materials were acquired, evaluated by project staff and practitioners in the field, and prepared for dissemination. Materials which were specific to the military were deleted, copyrighted materials were either omitted or approval for their use was obtained. These course packages contain curriculum resource materials which can be adapted to support vocational instruction and curriculum development.

The National Center Mission Statement

The National Center for Research in Vocational Education's mission is to increase the ability of diverse agencies, institutions, and organizations to solve educational problems relating to individual career planning, preparation, and progression. The National Center fulfills its mission by:

- Generating knowledge through research
- Developing educational programs and products
- Evaluating individual program needs and outcomes
- Installing educational programs and products
- Operating information systems and services
- Conducting leadership development and training programs

FOR FURTHER INFORMATION ABOUT
Military Curriculum Materials
WRITE OR CALL

Program Information Office
The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road, Columbus, Ohio 43210
Telephone: 614/486-3655 or Toll Free 800/848-4815 within the continental U.S. (except Ohio)

THE NATIONAL CENTER FOR RESEARCH IN VOCATIONAL EDUCATION

Military Curriculum Materials for Vocational and Technical Education

Information and Field Services Division

The National Center for Research in Vocational Education

Military Curriculum Materials Dissemination Is . . .

an activity to increase the accessibility of military developed curriculum materials to vocational and technical educators.

This project, funded by the U.S. Office of Education, includes the identification and acquisition of curriculum materials in print form from the Coast Guard, Air Force, Army, Marine Corps and Navy.

Access to military curriculum materials is provided through a "Joint Memorandum of Understanding" between the U.S. Office of Education and the Department of Defense.

The acquired materials are reviewed by staff and subject matter specialists, and courses deemed applicable to vocational and technical education are selected for dissemination.

The National Center for Research in Vocational Education is the U.S. Office of Education's designated representative to acquire the materials and conduct the project activities.

Project Staff:

Wesley E. Budke, Ph.D., Director
National Center Clearinghouse

Shirley A. Chase, Ph.D.
Project Director

What Materials Are Available?

One hundred twenty courses on microfiche (thirteen in paper form) and descriptions of each have been provided to the vocational Curriculum Coordination Centers and other instructional materials agencies for dissemination.

Course materials include programmed instruction, curriculum outlines, instructor guides, student workbooks and technical manuals.

The 120 courses represent the following sixteen vocational subject areas:

- Agriculture
- Aviation
- Building & Construction Trades
- Clerical Occupations
- Communications
- Drafting
- Electronics
- Engine Mechanics
- Food Service
- Health
- Heating & Air Conditioning
- Machine Shop
- Management & Supervision
- Meteorology & Navigation
- Photography
- Public Service

The number of courses and the subject areas represented will expand as additional materials with application to vocational and technical education are identified and selected for dissemination.

How Can These Materials Be Obtained?

Contact the Curriculum Coordination Center in your region for information on obtaining materials (e.g., availability and cost). They will respond to your request directly or refer you to an instructional materials agency closer to you.

CURRICULUM COORDINATION CENTERS

EAST CENTRAL
Rebecca S. Douglass
Director
100 North First Street
Springfield, IL 62777
217/782-0759

NORTHWEST
William Daniels
Director
Building 17
Airdustrial Park
Olympia, WA 98504
206/753-0879

MIDWEST
Robert Patton
Director
1515 West Sixth Ave.
Stillwater, OK 74704
405/377-2000

SOUTHEAST
James F. Shill, Ph.D.
Director
Mississippi State University
Drawer DX
Mississippi State, MS 39762
601/325-2510

NORTHEAST
Joseph F. Kelly, Ph.D.
Director
225 West State Street
Trenton, NJ 08625
609/292-6562

WESTERN
Lawrence F. H. Zane, Ph.D.
Director
1776 University Ave.
Honolulu, HI 96822
808/948-7834

CONSTRUCTION MECHANIC, ENGINE TUNE-UP 11 (DIESEL)

Table of Contents

Course Description — Page 1

Curriculum Outline

Unit 1.1 Introduction and Safety Precautions — Page 18

General Housekeeping - Information Sheet — Page 28

Unit 1.2 Engine Tune-up (Diesel) 11 — Page 37

Diesel Engine Tune-up, Cummins with P.T. Fuel System - Job Sheet — Page 80

Diesel Engine Tune-up, International with Roosa Master Fuel System - Job Sheet — Page 85

Diesel Engine Tune-up, GM In-Line and V6-71 - Job Sheet — Page 90

Developed by:
United States Navy

Development and Review Dates:
January 1975

D.O.T. No.:
620.281

Occupational Area:
Engine Mechanics

Target Audiences:
Grades 11-adult

Print Pages:
89

Cost:

Availability:
Military Curriculum Project, The Center for Vocational Education, 1960 Kenny Rd., Columbus, OH 43210

Contents:	Type of Materials:	Lesson Plans:	Programmed Text:	Student Workbook:	Handouts:	Text Materials:	Audio-Visuals:	Instructional Design:	Performance Objectives:	Tests:	Review Exercises:	Additional Materials Required:	Type of Instruction:	Group Instruction:	Individualized:	
Unit 1.1																
Introduction and Safety Precautions		•			•				•	*				•		
Unit 1.2																
Engine Tune-Up (Diesel) II		•			•	*	*		•	•		*		•	•	

* Materials are recommended but not provided.

THE CENTER FOR VOCATIONAL EDUCATION

Expires July 1, 1978

Course Description:

Students completing this course will be able to restore diesel engine performance to the manufacturer's specifications through troubleshooting and analyzing diesel engine fuel systems in their entirety and making minor and major adjustments to those components that directly affect engine performance. Students will be able to use appropriate hand tools, special tools, and shop equipment to test, adjust, and replace fuel system components that fail to meet the manufacturer's specifications.

This course consists of two units with one lesson in each, constituting 56 hours of classroom and shop instruction. The unit titles and hours follow:

Unit 1.1 – **Introduction and Safety Precaustions** (1 hour classroom)
Unit 1.2 – **Engine Tune-Up** (14 hours classroom, 41 hours shop)

This course consists of a single document containing both student and teacher materials. Instructor materials provided are an introduction to the course; an outline of training objectives; lists of texts, references, tools, equipment, training aids and devices, and training aids equipment; a master schedule; and lessons plans. The lesson plans contain an outline of instruction and activities for teachers and students. Student materials provided include three job sheets and one information sheet.

The texts for this course are not provided. Six manuals, two sets of slides, eight transparencies, and the following films are recommended for use with this course but are not provided:

OPE-001 Operation Hour Glass (Cummins Engine Co., 27 minutes)
TF-552368 Injector Timing for GM Diesel Series "71" using 70, 80 and 90 mm Injectors

3

8-8

SPECIAL CONSTRUCTION BATTALION TRAINING

CONSTRUCTION MECHANIC
334.2 ENGINE TUNE-UP II (DIESEL)

January 1975

TABLE OF CONTENTS

LETTER OF APPROVAL	i
RECORD OF CHANGE PAGE	ii
TITLE PAGE	iii
HOW TO USE INSTRUCTOR GUIDES	v - vi
COURSE DATA PAGE	1
OUTLINE OF TRAINING OBJECTIVES	2
ANNEX I - TEXTS	A-I-1
ANNEX II - REFERENCES	A-II-1
ANNEX III - TOOLS AND EQUIPMENT	A-III-1
ANNEX IV - TRAINING AIDS AND DEVICES	A-IV-1
ANNEX V - TRAINING AIDS EQUIPMENT	A-V-1
ANNEX VI - FORMS	A-VI-1
ANNEX VII - MASTER SCHEDULE	A-VII-1 - A-VII-3

HOW TO USE INSTRUCTOR GUIDES

Instructor Guides are provided for each topic and include supporting instructional materials identified by the topic number and preceded by a letter code designation. The letter code key is as follows:

SG - Student Guide
S - Supplement
PT - Pre-test
T - Test
FT - Final Test
FS - Formula Sheet
PLS - Programmed Learning Supplement

A complete listing of all supporting materials and aids documented with full descriptive titles in Annex.

The instructor guides are intended to be used as master lesson plans subject to personalization by the individual instructor. In all cases, it is expected that the instructor will study the references in preparation for annotating the guide. It is also exptected that each instructor will develop an appropriate introduction for each topic that will (1) create interest, (2) show the value of the topic to the student, (3) relate the topic to previous and future topics in the course, and (4) communicate the learning objectives to the student. Well prepared introduction will then provide the important motivational conditioning to establish readiness and effect for learning appropriate to each topic.

The first page of each instructor guide contains the following functional information:

1. Topic of Lesson.
2. Time in periods.
3. References.
4. Instructional aids.
5. Instruction aids.
6. Objectives.
7. Topic criterion test (as applicable).
8. Homework assignment (when applicable).
9. Tools and materials.

The pages following Page 1 of each instructor guide provide in a three column format the teaching/learning procedures for conducting the lesson. The left-hand column includes the outline of instructional content required by the objectives; the center column includes recommended instructor activities or methodology; the right-hand column contains recommended student learning activities.

How to Use Instructor Guides, Con't.

While the methodology and student learning activities documented in each instructor guide have been tested and proven to be effective for the lead school, those schools implementing this curriculum are encouraged to exercise creativity in designing learning exercises and conceiving methods and techniques to meet course objectives.

COURSE DATA PAGE

COURSE MISSION: To train selected construction mechanics in the knowledge and skill factors defined by the personnel readiness and capability program Construction Mechanics Skill 334.2.

PERSONNEL AND RATINGS ELIGIBLE: E-4 thru E-6

OBLIGATED SERVICE: None

NOBC/NEC: None

PHYSICAL REQUIREMENTS: None

SECURITY CLEARANCE REQUIRED: None

PREREQUISITE TRAINING AND/OR BASIC BATTERY TEST SCORE REQUIRED: None

RELATED TRAINING: Construction Mechanic "A" School

FOLLOW-ON TRAINING: Special Construction Battalion Training Course (SCBT) 334.3, Engine Tune-Up (DIESEL) III

EVALUATION: Unless otherwise specified, performance will be evaluated on a "Go/No-Go" basis

OUTLINE OF TRAINING OBJECTIVES

Title: Engine Tune-Up (Diesel) II

Unit 1.1: Introduction and Safety Precautions Contact Hours: 1

Terminal Objective: Upon completion of this unit each student will have registered for the course, received textbooks, complied with NCTC and CBC regulations governing the reporting and fighting of fires and shop safety procedures which pertain to him as a student at Special Construction Battalion Training.

Topic 1.1.1: Introduction and Safety Precautions 1

Enabling Objectives: Upon completion of this topic each student will be able to answer orally specific questions pertaining to the mission, regulations and organization of the command, and the method of reporting/ fighting a fire and the precautions to be observed to ensure personnel safety as established by NCTC and CBC regulations.
NOTE: Failure to meet this objective is not considered disqualifying. Information sheet will be kept in possession of student for use if needed.

Unit 1.2: Engine Tune-Up (Diesel) II Contact Hours: 55

Terminal Objective: Upon completion of this course each student will be able to restore diesel engine performance to manufacturer's specifications through troubleshooting and analyzing diesel engine fuel systems in their entirety while making minor and major adjustments to those components that directly effect engine performance. Procedures will be outlined in a job sheet. Each student will use appropriate handtools, special tools and shop equipment to test, adjust and replace fuel system components that fail to meet manufacturer's specifications. All performance will comply with manufacturer's specifications without deviation as specified in the job sheet.

Topic 1.2.1: Engine Tune-Up (Diesel) II 55

Enabling Objectives: Upon completion of this topic each student will be able to restore diesel engine performance to manufacturer's specifications through troubleshooting and analyzing diesel engine fuel systems in their entirety while making minor and major adjustments to those components that directly effect engine performance. Procedures will be outlined in a job sheet. Each student will use appropriate hand tools, special tools and shop equipment to test, adjust and replace fuel system components that fail to meet manufacturer's specifications. All performance will comply with manufacturer's specifications without deviation as specified in the job sheet.

ANNEX I

TEXTS

Roosa-Master Fuel Injection Pump for International Diesel Engines, Form ISS-1042-1.

International 429 Series Diesel Engine ISS-1503D

Cummins Tune-Up and Trouble-Shooting Bulletin No. 98364B-CE

Operation and Adjustment P.T. Fuel System Bulletin No. 983438-A

Caterpillar Service Manual

Inline 71 Engines Detroit Diesel Maintenance 6SE177

ANNEX II

REFERENCES

None

ANNEX III

TOOLS AND EQUIPMENT

Tools:

Kit Mechanic Hand Tools F/2 Men, NMCB Assy.,00501A/80013, 6 ea., $553.33

Kit Diesel Test and Service Tools, MNCB Assy., 00501A/80018, 1 ea., $2,168.33

Equipment:

Caterpillar Model D3306 Diesel Engines, 4 ea.

International Model UDT 429 Diesel Engines, 4 ea.

Cummins Model NH 250 Diesel Engines, 4 ea.

General Motors 6V-71 Diesel Engines, 5 ea.

ANNEX IV

TRAINING AIDS AND DEVICES

Films:

OPE-001, "Operation Hour Glass," Cummins Engine Co., (27 min)

TF-552368, "Injector Timing for GM Diesel Series "71" using 70, 80 and 90mm Injectors."

Slides:

Slide Series - Showing proper procedures for installing Kiene Test Equipment in the engine.

Slide Series - Showing proper tune-up procedures for Cummins NH 250 Diesel Engine.

Transparencies:

GM Diesel Valve Adjustment
Setting Injector Height, GM Diesel Engine
Caterpillar Fuel Pump Lifter Construction
Wear Between Caterpillar Injection Pump Plunger and Lifter Yoke
Caterpillar Fuel System (Fuel Flow)
Examples of Caterpillar Rack to the Pumps
Timing the Caterpillar Rack to the Pumps
Setting Caterpillar Pump Lifter Height

Locally Prepared Materials:

1. Job sheets.

   a. SCBT-334.2-CM-JS-1.2.1.1, "Diesel Engine Tune-Up, Cummins with P.T. Fuel System."

   b. SCBT-334.2-CM-JS-1.2.1.2, "Diesel Engine Tune-Up, International, with Roosa Master Fuel System."

   c. SCBT-334.2-CM-JS-1.2.1.3, "Diesel Engine Tune-Up GM Inline and V6-71."

2. Class Notes.

   a. SCBT-334.2-CM-CN-1.1.1.1, "Introduction and Safety Precautions."

   b. SCBT-334.2-CM-CN-1.2.1.1, "Engine Overhaul (Diesel) II."

ANNEX V

TRAINING AIDS EQUIPMENT

16mm Movie Projector

135mm Slide Projector

Movie Screen

ANNEX VI

FORMS

None

ANNEX VII

MASTER SCHEDULE

TOPIC NO.	TYPE	PERIOD	TITLE	RATIO
FIRST WEEK				
FIRST DAY				
1.1.1	C	1	Introduction and Safety Precautions	12/1
1.2.1	C	2	Engine Tune-Up (Diesel) II	12/1
		3		
		4		
		5		
		6		
		7		
SECOND DAY				
1.2.1	C	8	Engine Tune-Up (Diesel) II	12/1
		9		
		10		
		11		
		12		
		13		
		14		
THIRD DAY				
1.2.1	C	15	Engine Tune-Up (Diesel) II	12/1
		16		
		17		
		18		
		19		
		20		
		21		
FOURTH DAY				
1.2.1	P	22	Engine Tune-Up (Diesel) II	12/1
		23		
		24		
		25		
		26		
		27		
		28		
FIFTH DAY				
1.2.1	P	29	Engine Tune-Up (Diesel) II	12/1
		30		

Annex VII, Con't.

TOPIC NO.	TYPE	PERIOD	TITLE	RATIO
SECOND WEEK				
FIRST DAY				
1.2.1	P	1	Engine Tune-Up (Diesel) II	12/1
		2		
		3		
		4		
		5		
		6		
		7		
SECOND DAY				
1.2.1	P	8	Engine Tune-Up (Diesel) II	12/1
		9		
		10		
		11		
		12		
		13		
		14		
THIRD DAY				
1.2.1	P	15	Engine Tune-Up (Diesel) II	12/1
		16		
		17		
		18		
		19		
		20		
		21		
FOURTH DAY				
1.2.1	P	22	Engine Tune-Up (Diesel) II	12/1
		23		
		24		
		25		
		26		
		27		
		28		
FIFTH DAY				
1.2.1	P	29	Engine Tune-Up (Diesel) II	12/1
		30		

Annex VII, Con't.

Total Classroom Periods:	20
Total Practical Periods:	40
Total Period:	60
Total Weeks for Course:	02 Weeks

NOTE: Each period represents one contact hour

SCBT-334.2-CM-IG-1.1.1

NAVAL CONSTRUCTION TRAINING CENTER
PORT HUENEME, CALIFORNIA 93043
SPECIAL CONSTRUCTION BATTALION TRAINING COURSE (SCBT) 334.2

Classification: Unclassified

Topic: Introduction and Safety Precautions

Average Time: 1 Period (Class)

Instructional Materials:

A. Texts: None.

B. References.

1. NCTCINST 5400.4, (Current Series), Organizational Manual of NCTC.

2. "Safety Practices for Shore Activities," NAVMAT P-5100 (Jan 73), Chapter 5.

C. Tools and Equipment: None.

D. Training Aids and Devices.

1. Information sheets.

a. SCBT-334.2-CM-IS-1.1.1.1, "Introduction."

b. SCBT-334.2-CM-IS-1.1.1.2, "General Housekeeping."

E. Training Aids Equipment: None.

Terminal Objective: Upon completion of this unit each student will have registered for the course, received textbooks, complied with NCTC and CBC regulations governi the reporting and fighting of fires and shop safety procedures which pertain to him as a student at Special Construction Battalion Training.

Enabling Objectives: Upon completion of this topic each student will be abel to answer orally specific questions pertaining to the mission, regulations and organization of the command, and the method of reporting/fighting a fire and the precautions to be observed to ensure person safety as established by NCTC and CBC regulations. NOTE: Failure to meet this objective is not considered disqualifying. Information sheet will be kept in possession of student for use if needed.

Criterion Test: Each student will answer orally specifi questions pertaining to the mission, regulations and org ization of the command, and the method of reporting/ fighting a fire and the precaution to be observed to ensure personnel safety as established by NCTC and CBC regulations.

Homework: None.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to the Lesson.		
A. Establish contact.	I.A. Introduce self and topic.	
1. Name:		
2. Topic: Introduction and Safety Precautions.		
B. Establish readiness.	I.B. Motivate student.	
1. Purpose.		
2. Assignment.		
C. Establish effect.	I.C. Bring out need and value of material being presented.	
1. Value.		
a. Pass course.		
b. Perform better on the job.		
c. Get advanced.		
d. Be a better mechanic.		
D. Overview.	I.D. State learning objectives.	
	1. State information and materials necessary to guide students.	
	2. Notes may be taken.	
	3. Questions.	
	4. Classroom conduct.	
	5. Shop area conduct.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. Presentation:		
A. Introduction.		
1. Mission.		
a. Special training course.		
b. Higher state of readiness.	1.b. Stress.	
c. Compliance with COMCBPAC Instructions.		
2. Organization and chain of command.	A.2. Give names as appropriate.	
a. Commanding Officer.	a. Issue SCBT-334.2-CM-IS-1.1.1.1, and SCBT-334.2-CM-IS-1.1.1.2.	
b. Executive Officer.		
c. Training Officer.		
d. School Department Officer.		
e. Division Director.		
f. Senior Instructor.		
g. Primary Course Instructor.		
h. Class Petty Officer.		
i. Class Safety Petty Officer.		
3. Regulations and policies.		
a. Schedule.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Break procedures.		
c. Uniform regulations.	3.c. Maintain a military appearance at all times.	
(1) Working uniform of the day.		
d. Absenteeism.		
(1) Must be kept to a minimum.		
(2) Medical or dental sick call.	d.(2) Stress.	
(3) Permission to be absent.		
e. Parking.		
(1) Where.		
(2) When.		
(3) How.		
f. Visitors and phone calls.		
(1) Emergencies only.		
(2) Phone numbers.		
(a) School.		
g. Lost or damaged material.		
(1) Textbooks.		
(2) Publications.		

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(3) Tools.

(4) Materials.

(5) Statement of charges.

h. Off-limit areas.

(1) Restricted.

(2) Hard hat.

i. Clean-up procedures.

j. Problems.

(1) Scholastic.

(2) Personal.

(3) Counseling assistance.

4. Standards of student performance.

a. Written examinations.

b. Homework assignments.

c. Practical application.

5. Course outline.

a. Mission of course.

b. Course objectives.

c. Reading assignments.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
d. Class schedule.		
6. Grading system.	A.6. Unless otherwise specified trainee achievement will be evaluated by a combination of oral quizzes, written test and practical performance evaluations. Students must meet all learning objectives in order to pass.	
a. Homework.		
b. Practical application.		
c. Quizzes.		
d. Weekly tests.		
e. Final examination.		
B. Safety precautions.		
1. Personnel safety	B.1. Relate personal experience if applicable.	
a. Tripping hazards.		
(1) Tools and equipment.		a.(1) Stress.
(a) Hand tools.		
(b) Jacks.		
(c) Creepers.		
(d) Foreign objects.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Slippage hazards.		
(1) Oil and grease.		
(2) Water.		
(3) Paper.		
c. Eye hazards.		
(1) Face mask, goggles.		
(2) Hammering, chiseling.		
(3) Grinding.		
(4) Servicing batteries.		
d. Compressed air hazard.		
(1) Eye and face.		
(2) Skin penetration.		
e. Reporting accidents.		
(1) Class Safety Man.	e.(1) Introduce class safety man.	
(2) Instructor.		
(3) School director.		
(4) First aid when appropriate.		
2. Fire safety.		

OUTLINE OF INSTRUCTOR	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Avoiding and preventing fires.		
(1) Good housekeeping.	a.(1) Stress.	
(2) Proper storage of materials.		
(3) Smoking.		
b. Know evacuation routes.	2.b. Explain in detail evacuation route.	
(1) Classroom.		
(2) Shop area.		
c. Reporting fire.		
(1) Location of fire alarm switch.		
(2) Report to class safety man.		
d. Fighting fire.		
(1) Location of extinguishers.		
III. Application - oral questions.		
IV. Summary:		
A. Introduction.		
1. Mission.		
2. Organization.		
3. Regulations.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY

4. Standards of student performance.

5. Course outline.

6. Grading system.

B. Safety.

1. Personnel safety.

2. Fire safety.

V. Test: None.

VI. Homework: None.

42

43

MODIFICATIONS

Information sheet of this publication has (have) been deleted in adapting this material for inclusion in the "Trial Implementation of a Model System to Provide Military Curriculum Materials for Use in Vocational and Technical Education." Deleted material involves extensive use of military forms, procedures, systems, etc. and was not considered appropriate for use in vocational and technical education.

NAVAL CONSTRUCTION TRAINING CENTER
PORT HUENEME, CALIFORNIA 93043
SPECIAL CONSTRUCTION BATTAION TRAINING COURSE (SCBT) 334.2

INFORMATION SHEET

Title: General Housekeeping

1. Cleanliness.

a. Floors and other exposed areas.

(1) The distribution center, garage or workshop shall be thoroughly inspected daily and maintained in a clean and orderly state. Floors and other exposed surfaces shall be kept scrupulously clean. Hazards on floors such as oil, grease or loose tools, which might result in fire, slipping, tripping or falling shall be eliminated as quickly as possible.

b. Grease Rack.

(1) Particular care shall be taken to maintain cleanliness in area around the grease rack as well as in the rack itself. Be sure that grease connections are fast to car connections when greasing a car. At the close of work each day, clean and grease rack and floor.

2. Ventilation.

a. Garages and repair shops shall be well ventilated for protection of service personel against accumulations of carbon monoxide. If these spaces are not equipped with adequate ventilation, doors shall be opened whenever engines are running.

3. Illumination.

a. Adequate illumination shall be provided and utilized for all general work areas, including work benches and lubrication pits.

4. Safety During Repairs.

a. Use warning signs or barricades to protect personnel when construction, repair work or painting is in progress.

5. Avoiding Tripping Hazards.

a. Covers on sidewalk, boxes, fuel tanks and pipe openings shall be flush with surfaces and shall be kept closed when not in use. All tools and equipment shall be kept in their proper places when not in use and shall part-cularly be kept out of walkways to avoid tripping hazards.

PROTECTION OF PERSONNEL

The following personnel protective equipment shall be used by workmen in a distribution center, garage or workshop.

1. Apparel Required.

a. Mechanics shall wear goggles or face shilds, rubber gloves, aprons, safety shoes and special gloves as needed.

2. Goggles.

a. Goggles shall be worn for all grinding, welding, chipping, cutting and when using compressed air, or for similar operations designated by local command. The object of tinted filter linses is not only to diminish the intensity of visible light to a point where glare is reduced to a minimum so that the welding zone can be readily seen, but also to protect the welder from harmful infrared and ultraviolet radiation from the arc or flame.

3. Prohibited Against Rings.

a. Rings shall not be worn by workmen servicing batteries or working on motor vehicles.

FIRE PREVENTION

1. Fire-Fighting Apparatus.

a. Fire fighting apparatus shall be kept in proper working condition and well distrubited with locations marked in accordance with NAVDOCKS P-309, Application of Color to Shore Establishments. Garage personnel should be trained in the operation of this equipment.

2. Smoking.

a. Smoking or the carrying of lighted pipes, cigars or cigarettes near pumps, batteries or vent pipes shall be prohibited.

EQUIPMENT AND TOOLS

The pertinent precautions of Chapter 14 apply in addition to the rules in this chapter.

1. General Rules.

a. Keep tools in their proper places when not in use.

b. Use only the correct tools for a particular job.

30

c. Never use defective tools.

d. Keep tools and hands free of grease. Clean tools with an approved solvent.

e. When using a bar on springs, work bar away from the face.

f. Lift small batteries with battery straps designed for this purpose. On large batteries use insulated lifting bridles designed for this purpose.

2. Blow Torches.

a. Blow torches shall not be used to clean crankcase, transmission, radiators or grease guns; steam, hot water or other suitable degreasers shall be employed for this purpose.

3. Grease Guns.

a. Grease guns must be handled carefully and used only for the purpose intended. Serious injury has resulted when grease has been shot out of a grease gun in horseplay. NEVER point the gun toward another person.

4. Lube Dispenser.

a. Keep the dispenser where it will be out of the way and check it at regular intervals for leaks.

5. Mobile Grease Cart.

a. The mobile grease cart must returned to it's proper place immediately after it is used and the hose must never be left lying along the floor.

REPAIRING AND SERVICING VEHICLES

1. Body and Engine Work.

a. Entering the garage. When a car is being driven into a garage personnel shall stand well out of it's path. Nevery try to service a moving vehicle.

b. Securing the hood. Work shall not be started under a hood of a vehicle unless the hood has been firmly secured in the open position. Hood holddown clamps or locking devices shall be kept in good condition. Additional holddown clamps should be installed where necessary.

c. Broken glass. Care shall be taken to avoid injuries from broken windshild, light globes, lenses or jagged pieces of metal around the car.

d. Radiator. If the radiator is steaming, the hands should be protected with a large rag, and the steam allowed to escape before removing the cap entirely. Matches shall not be used when looking into a radiator.

e. Cranking the engine. If it is necessary to crank an engine by hand, the brake must first be set and the gearshift placed in neutral. In cranking the handle should be grasped with the thumb alongside the fingers and not around the crank. If possible, start the engine by a series of quick pulls. Spinning should always be started with an UPWARD PULL; never with a downward thrust.

f. Lifting heavy parts. To prevent personal injury when removing or replacing heavy parts, such as gear units or hub and drum assemblies, mechanics should always use a hoist, jack or dolly.

g. Restriction on leaded gasoline. Do not use gasoline containing tetraethyl lead for anything but motor fuel. If this type of gasoline is spilled on the body, wash it off thoroughly, as it is a deadly poison.

2. Vehicle Stands. Approved metal vehicle stands shall always be used when work is being done under a vehicle from which the wheels have been removed. Wooden blocks or horses shall not be used for this purpose. Hydraulic lifts are permissible.

3. Dump Trucks. Before starting repair on a dump truck, with the dump body in a raised position, the body shall be secured by inserting the safety pins in the safety locks or in the absence of such locks, the body shall be secured with sturdy blocking or triangular steel stands designed for this purpose.

4. Working on Raised Vehicles.

a. Jacks.

(1) Inspection. Jacks shall be inspected visually for cracks, looseness and wear. If there is any doubt about the condition of a jack, it must not be used.

(2) Blocking. Be certain that a vehicle is properly blocked when working under it. Do not depend entirely on jacks.

(3) Centering. Center the service jack on the axle when a wheel is to be removed from a car. The jack should always be set on a solid footing.

(4) Capacity. Never use a jack for a load in excess of it's rated capacity.

(5) Handle. Place the jack so that the swing of it's handle will be unobstructed. Never leave a jack standing under a load with the handle in the socket.

(6) Keeping clear. Never lean over a jack handle or handle socket under load. Keep the body clear of the car, in case it should suddenly start to roll.

b. Hydraulic lifts.

(1) Inspection. Inspect hoists at regular intervals for oil leaks, oil level and proper lubrication. Check overhead connections at regular intervals and make frequent inspections of safety locks on gears; the teeth of gear locks should not be worn or chipped. Never use a defective hoist.

(2) Putting vehcile on lift. Do not stand in front of a hoist while a motor vehicle is being guided onto it.

(3) Securing Vehicle. Never permit occupants to remain in a vehicle when it is to be lifted. Be sure, before lifting a vehicle, that the ignition is off, the gears are in neugral, the wheels are blocked and the doors are closed.

(4) Freewheel lift. If the freewheel type of lift is used, be sure that the car is properly balanced. Raise the lift just enough to take the weight off the wheel, check the blocks and knee-action plates to determine whether the car is resting properly and set the hand brake.

(5) Raising the hoist.

(a) When the hoist is raised, use the safety leg and check to see that safety catches are secured.

(b) Never rock the car when the hoist is raised.

(c) Raise and lower the car slowly. Do not try to rush the action of the hoist, as the gears may slip.

(d) Do not attempt to raise a vehicle that may be heavier than the capacity of the hoist.

(e) Except for cleaning purposes, never raise the hoist when it is not in use.

(6) Self protection during work. When working on raised objects, stand in such a position that your feet will not be crushed if the object should fall.

5. Car pits.

a. The use of existing pits, elevated racks and various mechanical lifts for lubrication and other works is acceptable but not recommended except pits used for railroad equipment. Twin most adjustable hydraulic air-oil operated, flush-floor mounted lifts are recommended for this purpose and shall be specified in new construction. In the use of existing pits, the following precautions shall apply:

(1) Only approved cleaning compounds shall be used in car pits. Never use gasoline or other flammable solvents.

(2) Do not place tools or debris on pit steps and always keep the the steps free of oil and grease.

(3) Arrange for proper lighting in the pits.

(4) Keep the drain open.

(5) Erect adequate safequards around pits.

(6) Do not allow unauthorized personnel in pits.

(7) Keep guard chains for pits in place when the pits are not in use.

6. Charging Batteries.

a. Beware of burns and shocks when charging batteries. Use rubber gloves when necessary.

b. Vent caps should be replaced before attaching or detaching charger cables; fumes arising from batteries in the recharging line are flammable.

c. Be sure that connections to batteries are properly made and secured.

d. Care shall be used in handling battery acids. When preparing electrolyte, the acid shall always be poured into the water.

e. Never "flash" or short-circuit a battery to test it's strength. As stated above, the hydrogen gas is highly inflammable and a spark may cause an explosion.

7. Installing Tires.

a. Removing hub cap. When removing a hub cap, hold one hand against the side of the cap so that is does not fly into your body when it is released.

b. Removing the Tire. When removing a tire from a wheel, remove the core from the valve stem and turn the wheel until the stem is on the lower quarter, which can be rolled off the wheel onto the ground. Such a procedure is particularly useful when changing truck or bus tires.

c. Cracked Rims. In replacing tires, take care that the rims are in good condition and that the lug nuts are tight.

d. Lock Rings. See that the lock rings are properly installed. This should be done before the tire is fully inflated.

e. Inflating the Tire. Inspect a tire for defects and determine the proper pressure before inflating. When inflating a tire, turn your face away from it; never hold it between your legs. Tires on split wheels must be deflated before removing the wheel from the vehicle and inflated after installing the wheel on the vehicle.

f. Installing Tire on Wheel. When putting a tire on a wheel, turn the wheel until the opening for the valve stem is on top. Then, resting the tire against the wheel with the stem on top, stoop, place hand on each lower quarter of the tire and lift it into place.

g. Split Wheels. All bolts on split or two piece wheels must be tightly secured before inflating tire. Tire must be deflated before loosening bolts.

8. Sodium Filled Valves. Automotive shop mechanics and supervisors shall be familiar with the hazards of the metallic sodium found in "sodium filled" engine valves. Special provisions should be made for the temporary storage and disposal of the parts when they are replaced. They shall not be discarded to the metal scrap pile, but shall be shipped to the nearest naval ammunition depot for proper disposal. They shall be appropriately tagged for identification.

FUELING MOTOR VEHICLES

1. Authorized Personnel. Only authorized personnel shall be allowed to fuel motor vehicles and they shall have a thorough knowledge of the hazards involved.

2. Care of Pumps.

a. If the pump is electrically operated, be sure that the motor is shut off after the gasoline has been delivered.

b. Check at regular intervals for leaks at pipe connections, stuffing box and meter. If leaks are found, do not attempt to repair them. Call a repairman, and keep the pumps out of service until the repairs have been made.

c. Have the base bolts secure at all times.

d. Do not attempt to make electrical repairs on pumps. Call a serviceman.

3. Using Fueling Equipment.

a. Equipment Maintenance. Do not use leaky hose, pumps, valves or faucets. Arrange for them to be repaired at once.

b. Gasoline Containers. Gasoline shall not be left standing in unlabeled containers; metal safety cans must always be used. If gasoline is to be carried away, it shall be done only when in the metal safety can, tightly capped and suitably marked.

c. Automatic Dispensing Nozzles. Automatic shut-off dispensing nozzles may be used without attendance, only if the nozzles are approved and listed as such, with limitation by the Underwirter's Laboratories, Inc. When such nozzles are used without attendance, the following precautions shall be observed:

(1) The engine and lights of the vehicle being fueled shall be shut off.

(2) Exhaust extensions of operating internal combustion engines shall be at least ten feet from the point of fuel delivery.

(3) Each automatic shut-off nozzle shall be checked daily by attendants for wear or damage, shall be checked weekly by the station fire department personnel, and removed and repaired or adjusted by a manufacturer's representative at six-month intervals or after 50,000 cycles of operation, whichever comes first. Records of these inspections shall be kept by the service station.

(4) A 50 pound wheeled CO^2 or 30 pound dry chemical extinguisher shall be provided at each service station where such nozzles are used.

(5) Attendants shall be fully instructed in the regular inspection of the automatic shut off nozzles and the use of the fire extinguishers.

4. Fueling Procedures.

a. Bonding. To prevent electrical static discharges, tank and nozzle shall be kept in metallic contact while gasoline is being poured into the fuel tank. This rule applies to all kinds of motor vehicles and expecially to gasoline trucks.

36

b. Proximity of Anntennas. The fueling of motor vehicles in the proximity of anntenas and antenna down leads should be avoided or conducted with special precautions. An ungrounded automobile, ungrounded filling nozzle or merely the attendant's body in close proximtiy to transmitting antennas and down leads, may produce sparks sufficient to ignite gasoline vapor when the nozzle comes in contact with the tank opening. Pump nozzles must be grounded at all times and motor vehicles, when fueling, must also be grounded before opening the tank.

c. Danger from Fumes. To minimize the effects of gasoline fumes, the face should be turned away from the fuel pipes while making deliveries of gasoline. Always drain the nozzle before removing it from the tank of a vehicle.

d. Batter Terminals. If the gasoline tank is located under the seat, do not permit the nozzle to toudn the battery terminals.

e. Danger of Overfilling. Take special care that fuel tanks are not filled to overflowing. This is particularly important in the case of motorcycles.

5. Fire During Fueling.

a. If fire should break out in the fuel spout during fueling, remove the hose from the tank immediately and smother the fire with CO^2, dry chemical or foam extinguishers, dirt, sand or a wet cloth (preferably chamois, if it is available).

6. After-Fueling Procedures.

a. Caps and Plugs. Replace caps or bplus securely immediately after using drums or barrels containing gasoline. Caps and plugs should be in place when drums or barrels are empty and these containers should be removed from the garage as soon as possible.

b. Pumps. If the gasoline pump is of the visible bowl type, drain the gasoline from the bowl when securing the pumps.

c. Measuring Cans. Turn empty measuring cans bottom up and dry them thoroughly before storing them.

d. Personal Hygeine. After handling gasoline, mechanics should wash their hands thoroughly before eating. Clothing that has become soaked with gasoline should be changed immediately, to prevent possible burns and dermatitis of the skin. Gasoline soaked rags should never be carried in the pocket.

NAVAL CONSTRUCTION TRAINING CENTER
PORT HUENEME, CALIFORNIA 93043
SPECIAL CONSTRUCTION BATTALION TRAINING COURSE (SCBT) 334.2

Classification: Unclassified

Topic: Engine Tune-Up (Diesel) II

Average Time: 19 Periods (Class)
40 Periods (Pract)

Instructional Materials:

A. Texts:

1. Roosa-Master Fuel Injection Pump for International Diesel Engines from ISS-1042-1.

2. International 429 Series Diesel Engine, ISS-1503D.

3. Cummins Tune-Up and Trouble-Shooting Bulletin No. 983643-CE.

4. Operation and Adjustment PT Fuel System Bulletin No. 983438-A.

5. Caterpillar Service Manual.

6. In-Line 71 Engines Engines Detroit Diesel Maintenance 68E177.

B. References.

1. None.

Terminal Objective: Upon completion of this course each student will be able to restore diesel engine performance to manufacturer's specifications through troubleshooting an analyzing diesel engine fuel systems in their entirety whil making minor and major adjustments to those components that directy effect engine performance. Procedures will be outlined in a job sheet. Each student will use appropriate handtools, special tools and shop equipment to test, adjust and replace fuel system components that fail to meet manufacturer's specifications. All performance will comply with manufacturer's specifications without deviation as specified in the job sheet.

Enabling Objectives: Upon completion of this topic each student will be able to restore diesel engine performance to manufacturer's specifications through troublshooting and analyzing diesel engine fuel systems in their entirety while making minor and major adjustments to those component that directly effect engine performance. Procedures will b outlined in a job sheet. Each student will use appropriate hand tools, special tools and shop equipment to test, adjust and replace fuel system components that fail to meet manufacturer's specifications. All performance will comply with manufacturer's specifications without deviation as specified in job sheet.

C. Tools and Equipment.

1. Tools.

a. Mechanic Hand Tools Kit, F/2 men, NMCB Assy.

b. Diesel Test and Service Tools Kit, NMCB Assy.

2. Equipment.

a. Caterpillar Model D3306, Diesel Engines.

b. International Model UDT 429, Diesel Engine.

c. Cummins Model NH 250, Diesel Engine.

d. General Motors 6V-71, Diesel Engine.

D. Training Aids and Devices.

1. Films.

a. "Operation Hourglass," Cummins Engine Company.

b. TF-55-2368, "Injector Timing for GM Diesel Series "71" using 70, 80, and 90MM Injectors."

2. Transparencies.

a. GM Diesel Valve Adjustment.

b. Setting Injector Height, GM Diesel Engine.

Criterion Test: Tune a specified diesel engine to restore engine performance to meet manufacturer's specifications, using appropriate handtools, special tools and shop equipment. He will adjust valves, set low and high idles, troubleshooting, analyze and isolate diesel fuel system malfunctions. All performance will comply with manufacturer's specifications without deviation as specified in the job sheets SCBT-334.2-CM-JS-1.2.1.1 and SCBT-334.2-CM-JS-1.2.1.2.

Homework: None.

c. Caterpillar Fuel Pump Lifter Construction.

d. Wear between Caterpillar Injection Pump Plunger and Lifter Yoke.

e. Caterpillar Fuel System (Fuel Flow).

f. Examples of Caterpillar Rack Settings (3H1690).

g. Timing the Caterpillar Rack to the Pumps.

h. Setting Caterpillar Pump Lifter Height.

3. Slides.

a. Series of slides showing proper procedures in installing Kiene test equipment on the engine as illustrated in section 2, pp. 39 - 43, in service manual for International Diesel Engines, Form ISS-1042-1.

b. Series of slides showing proper tune-up procedures for Cummins, NH250 as outlined in Cummins Tune-Up and Troubleshooting Bulletin No. 983643-CE 3-71 pages and illustrations as required.

4. Locally Prepared Materials.

a. Job sheets.

(1) SCBT-334.2-CM-JS-1.2.1.1, "Diesel Engine Tune-Up Cummins with P.T. Fuel System."

(2) SCBT-334.2-CM-JS-1.2.1.2, "Diesel Engine Tune-Up, International with Roosa Master Fuel System."

(3) SCBT-334.2-CM-JS-1.2.1.3, "Diesel Engine Tune-Up, GM In-Line and V6-71."

b. Class Notes.

(1) SCBT-334.2-CM-CN-1.2.1.1, "Engine Overhaul (Diesel) II."

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
I. Introduction to the Lesson:		
A. Establish contact.	I.A. Introduce self and topic.	
1. Name:		
2. Topic: Engine Tune-Up (Diesel) II		
B. Establish readiness.	I.B. Motivate student.	
1. Purpose.		
2. Assignment.		
C. Establish effect.	I.C. Bring out need and value of material being presented.	
1. Value.		
a. Pass course.		
b. Perform better on the job.		
c. Get advanced.		
d. Be a better mechanic.		
D. Overview.	I.D. State learning objectives.	
	1. State information and materials necessary to guide student.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
II. Presentation:		
A. General checks.	II.A. Demonstrate these checks on any actual engine application, either test stand mounted or actual piece of equipment.	
NOTE: The following items are common to most engines and should be checked prior to actual work of engine tune-up.		
1. Air systems.		A.1. Perform general checks prior to tuning a specific engine either test stand mounted or actual piece of equipment.
a. Air cleaner.		
(1) Dry type.		
(a) Blow clean with low pressure air from inside to outside.		
(b) Replace if oil soaked or shows evidence of any holes.		
(2) Wet type.		
(a) Wash thoroughly in solvent and dry.		
(b) Refill only to manufacturer's specifications.		
b. Related piping.	1.b. Explain the importance of having a clean air system.	

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(1) Inspect hose and clamps for tightness and damage.		
(2) Inspect accessible gaskets on air connections and intake manifold.		
NOTE: Dirt entering the air system can ruin any engine in very short order.		
2. Turbocharger and manifold piping.	A.2. Stress proper care of turbocharger and related components.	
a. Inspect for any signs of excessive passing through the turbocharger seals.		
b. Consult manufacturer's manual for procedures to troubleshoot turbocharger.		
c. Inspect turbocharger oil supply and drain lines for kinking abrasion or other damage.		
3. External fuel system.		
a. Check for fuel in fuel tank.		
b. Inspect all fuel lines for kinks, leaks or abrasion damage.		
c. Check fuel filters, change if needed.		
4. V-belt drives.		
a. Maintain proper belt tension as required by manufacturer.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Replace worn belts.		
5. Batteries.		
a. Check terminals, clean if required.		
b. Proper electrolite level.		
B. Caterpillar engine tune-up procedures.		
1. Valve adjustment.		
a. Bring engine up to operating temperature.		
b. Remove valve covers.		
c. Position number one cylinder to T.D.C.		
NOTE: If using the "Buddy throw" method, you may start with any cylinder in the engine firing order provided that cylinder is on T.D.C. and it's running mate is in the rock position.		
d. Using a feeler gauge of a specified thickness set both the intake and exhaust valves of that cylinder.		
e. Set the remaining valves in the normal firing order of the engine.		
2. Compression release adjustment.	B.2. Issue Caterpillar Service Manual and take class to shop and demonstrate procedures for valve and compression release adjustment.	B.2. Observe demonstration and follow procedures in manufacturer's manual.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

a. Make after valve adjustment, prior to going to next cylinder.

b. Compression release in RUN position.

c. Adjust cap nut to obtain 0.025" - 0.030" clearance between the rocker arm and the compression release push rod.

3. Fuel pump lifter setting.

a. Clean pump housing.

b. Remove fuel injection pumps.

(1) Keep in order.

(2) Replace yokes with visible wear.

c. Disconnect the rack from the governor linkage.

d. Determine lifter setting.

(1) Check the specification section of the manufacturer's manual.

e. Position engine.

(1) T.D.C. compression, corresponding cylinder.

(2) Observe valves for proper positioning.

f. Measure distance.

(1) Pump housing top to lifter yoke contact point.

(2) Use depth micrometer.

g. Adjustment.

(1) If variation exceeds 0.001".

(2) Use special wrench if available.

NOTE: To insure lifter was set a proper position rotate engine a few more degrees in the direction of engine rotation and recheck distance. Distance should be less than the original reading.

h. Continue checking in normal firing order of engine.

4. Fuel pump rack setting.

a. Disconnect the rack from the governor linkage.

(1) Eliminate governor spring tension on the rack.

b. Remove fuel injection pump.

(1) Nearest governor.

c. Insert rack setting gauge 3H1690.

(1) Align the mark on the gear of the gauge with the mark on the fuel rack.

72

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

d. Remove housing on rear of the fuel pump housing.

(1) Gain access to the torque spring and shims.

e. Determine correct setting.

(1) Refer to manufacturer's specifications.

f. Move fuel rack to full fuel position.

(1) Collar on the rack touches but does not move the torque spring.

g. Adjustment.

(1) Add or remove shims to obtain proper rack setting on the rack in the correct position.

NOTE: If shims are added or removed, be sure the parts are re-instated in the proper location.

h. Remove gauge.

i. Replace injection pumps.

(1) Align the mark on the pump plunger gear segment with the mark on the fuel rack.

j. Connect fuel rack and governor linkage.

5. Governor speed adjustment.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
a. Low idle speed.		
(1) Turn idle speed screw.		
(a) Top of governor housing.		
(b) Clockwise to decrease the speed.		
(c) Counterclockwise to increase the speed.		
(2) Set to manufacturer's specifications.		
b. High idle (governed speed) adjustment.		
(1) Turn high idle speed screw.		
(a) Top of governor housing.		
(b) Clockwise to decrease the speed.		
(c) Countercloskcwise to increase the speed.		
(2) Set to manufacturer's specifications.	b.(2) Demonstrate fuel pump lifter setting, rack setting and governor speed adjustment.	b.(2) Follow tune-up procedures while following steps given in service manual.
	b.(2) Direct and supervise, student particle in tune-up of caterpillar diesel engine.	b.(2) Follow demonstration while referring to step in manufacturer's manual.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

b.(2) Practice caterpillar engine tune-up using manufacturer's manual

C. Cummins Engine Tune-up Procedures.

1. Injector removal, inspection and adjustment.

a. Remove rocker covers.

NOTE: Check the inside of the covers for presence of water condensation.

b. Loosen the injector rocker lever adjusting nut on all cylinders.

c. Rotate engine until the first "VS" mark on the pulley or damper is aligned with the index mark on the housing.

d. Take the adjusting screw out of the center rocker lever on the cylinder that is T.D.C. corresponding to "VS" marks.

e. Remove injector.

NOTE: If type "D" injector remove the link, "B" and "C" type injectors the link is not removable.

f. Inspect injector for any abnormal wear or conditions.

g. Clean the cylinder head injector seat of all carbon.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

NOTE: A shaped stick and rag, or a suitable cleaning brush will suffice for this operation. Never use any hard tool for this procedure.

h. Install new seal rings, lubricate and install injector into the head.

NOTE: Inlet screen has to be positioned at 12 to 1 o'clock as viewed from the fuel pump side.

i. Place a clean rag over the injector. Using a hammer handle positioned on the rag over the plunger flange, snap the injector to it's seat with a sharp hand blow on the hammer head.

j. Assemble the link in the plunger and engage the rocker lever.

k. Use an inch/lb torque wrench and in a near continuous motion draw the injector adjusting screw to it's specified torque.

NOTE: After the first injector has been inspected and found to be in good condition, it is not necessary to inspect or remove other injectors unless the engine runs as though there is a faulty cylinder.

2. Valve crosshead adjustment.

a. Loosen the adjusting screw lock-nut and back off the adjusting screw one turn.

51

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
b. Use light finger pressure at the rocker lever contact surface to hold crosshead in ntact with the valve stem nearest the pushrod.		
c. Turn adjusting screw down until in contacts it's mating valve stem.		
d. For new crosshead and guides, advance the adjusting screw 20° more to straighten the stem in it's guide, worn crosshead may be advanced 30° to the straighten the stem in it's guide.		
e. Hold the adjusting screw in this position and tighten locknut to specified torque.		
3. Valve adjustment.		
NOTE: On engines equipped with compression release apparatus be sure that shaft is properly adjusted before adjusting valves.		
a. Using a specified thickness gauge turn the adjusting screw to obtain a good contact on the thickness gauge.		
b. Adjust both the intake and exhaust valves.		
c. Tighten lock nuts.	3.c. Issue job sheet and take class to shop, demonstrate injected service valve cross-head adjustment and valve adjustment.	3.c. Observe demonstration and follow steps outlined in job sheet.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

d. Bar engine over in direction or rotation and firing order, and set the rest of the injectors, crossheads and valves.

e. Install valve covers.

4. Fuel pump.

a. Fuel pump filter screens.

(1) Remove cap.

(2) Lift screens out and inspect magnet for metal particles.

NOTE: Large particles show excessive wear in gear pump.

(3) Clean screen.

(4) Re-install and torque to specified limits.

5. Engine idle speed.

a. Low idle.

(1) Attach tachometer to the drive outlet on top of the fuel pump.

(2) Remove pipe plug from spring pack cover.

84

(3) Turn idle screw in to increase or out to decrease speed.

(4) Replace pipe plug.

NOTE. Engine idle speed changes when the housing fills with fuel.

b. High idle.

(1) Attach tachometer to the drive outlet on top of the fuel pump.

NOTE: If high idle has to be changed, shims will have to be installed or removed from beneath the governor high speed spring and the high - speed spring retainer.

(2) Shut engine down.

(3) Remove spring pack cover.

(4) Remove snap ring.

(5) Increase of decreaseshims to regulate engine speed. Each .001 inch shim will increase or decrease engine speed by 2 rpm.

NOTE: Never set maximum speed to please an operator.

c. Rear throttle screw adjustment.

(1) Remove 1/8 inch pipe plug from the side of the fuel shut-off valve on top of the pumps and install ST-435 pressure gauge.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(2) Start engine, purge air from the pumps.

(3) Snap the throttle fully open and carefully watch gauge.

NOTE: This procedure has to be done two or three times to get a correct reading.

(4) Turn the rear throttle screw out until the highest fuel manifold pressure reading is obtained.

(5) Turn screw inward until pressure drops 5 PSI.

(6) Lock screw in place.

NOTE: Refer to specification sheet for the engine model. Keep in mind that snap fuel pressure readings are 3 to 5 PSI higher than a steady reading would be under load.

d. Forward throttle screw or throttle linkage adjustment.

(1) Operate warmed-up engine at idle speed.

(2) Screw forward throttle screw inward until engine begins gaining speed.

(3) Back out screw two turns and lock.

(4) Remove spring pack cover plug and adjust governor screw.

88

(5) (1) 5 - 10 below idle speed.

(6) Replace plug and run engine until all air is purged from system.

(7) Turn forward screw inward to obtain correct idle speed.

e. Checking pump operation.

(1) Maximum manifold pressure.

(a) ST-435 gauge installed at shut-off valve.

(b) Operate engine 400 rpm below governed speed.

(c) Accelerate to governed speed.

1. Observe gauge for specified pressure.

2. Maximum pressure is adjusted by removing or installing shims in pressure regulating valve.

(2) Inlet restriction check.

(a) ST-434 (Vacuum Gauge) install at gear pump inlet.

(b) Operate warmed up engine 5 minutes after installation gauge.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
1. To purge any air in system.		
(c) Observe gauge readings.		
1. Should not exceed 8" to 8.5" vacuum.		
(3) Suction side air leakage check.		
(a) Install sight gauge on pump inlet side and operate engine.		
1. A 1/2" line of large bubbles indicates an air leak.	(a)1. Take class to shop and demonstrate fuel pump service.	(a)1. Follow demonstration while referring to job sheet.
	Direct and supervise student practice in tune-up of Cummins Diesel engine.	Practice tune-up of Cummins Diesel engine in compliance with manufacturer's specifications without deviation as specified in the job sheet.
D. International Diesel Engine Tune-Up.		
1. Valve adjustment.		
a. Start and bring engine up to operating temperature.		
b. Remove valve cover.		
c. Rotate crankshaft until number one piston is on the compression stroke.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
NOTE: The timing pointer on the front cover will be in line with the T.D.C. mark on the vibration damper when No. 1 piston is T.D.C.		
d. Loosen rocker arm lock-nuts.		
e. Use a feeler gauge of a specified thickness and turn the rocker arm adjusting screw in or out until the correct feeler gauge clearance is obtained.		
f. Tighten rocker arm lock nuts.	1.f. Issue job sheet and take class to shop and demonstrate valve adjustment.	1.f. Observe demonstration and follow job sheet procedures.
NOTE: Set both intake and exhaust nuts.		
2. Injection nozzles and injectors.		
NOTE: International Diesel engines employ either injection nozzles or injectors.		
a. Nozzles.		
(1) No service usually required during tune-up unless there is a faulty cylinder.		
(2) Nozzles are usually replaced as a unit.		
b. Injectors.		
(1) Removal.		
(a) Remove valve cover.		

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(b) Disconnect fuel lines.

(c) Backout injector adjusting screw.

(d) Move push rods to one side.

(e) Remove injector crab screw and remove injector crab.

(f) Remove injector from it's dowelled location in the cylinder head.

(2) Disassembly, inspect, repair and reassemble injectors in accordance with the manufacturer's manual.

(3) Installation.

(a) Clean injector tube.

(b) Place the injector into position by engaging the injector dowel pin in the locating hole in the cylinder head.

(c) Install the injector crab and torque to specifications.

(d) Install the injector push rod and insert the rocker arm socket, into the push rod cup.

96

(e) Connect both fuel lines to the injector.

(4) Injector adjustment.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(a) Tighten adjusting screw until the plunger just bottoms. (b) Loosen the adjusting screw 1/2 turn. (c) Use an inch/pound torque wrench and socket adapter D1280, tighten adjusting screw to 35 inch/pounds cold setting.	(4)(c) Take class to shop and demonstrate nozzle and injector service.	(4)(c) Observe demonstration and follow job sheet procedures.

NOTE: Injector adjustment must be made prior to valve adjustment.

3. Roosa Master fuel injection pump testing.

NOTE: The following tests are conducted with the pump mounted on an operating engine. Kiene test equipment must be available.

a. High idle adjustment.

(1) Disconnect throttle linkage.

(2) Hold throttle level all the way to the rear.

(3) Adjust the high idle stop screw until the specified high idle speed is obtained.

b. Transfer pump pressure.

(1) Install the compound gauge, assembly (tool No. 4071) in the pressure trap of the transfer pump.

(2) Operate engine at high idle.

(3) Record the reading compare to manufacturer's specifications.

(4) If the reading is low remove the compound gauge assembly and install compound gauge assembly in the inlet fitting of the transfer pump.

(5) Measure vacuum at inlet fitting of transfer pump. Record and compare to manufacturer's specifications.

NOTE: If the check shows the transfer pump and pressure regulating valve to be in a serviceable condition. Required supply pressure may be achieved by adjusting the pressure regulating valve.

c. Low idle.

(1) Disconnect the linkage.

(2) Move throttle lever of the pump forward until engine speed drops to 500 to 600 rpm.

(3) Turn idle screw in or out until low idle speed is obtained.

(4) Lock screw in place.

d. Speed advance operation (Model DC pump only).

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(1) Install the No. 13366 plastic timing window.

(2) Align the following timing lines.

(a) Timing line on the governor weight retainer aligns with the cam timing line.

(b) Timing marks on the vibration damper and the front case.

NOTE: If timing marks do not align, remove and reinstall the pump in accordance with manufacturer's procedures.

(3) Start engine, run at low idle and observe the cam line, it should not move.

(4) Increase engine speed.

NOTE: The cam should start to advance somewhere between 650 and 1,000 rpm.

(4) Record and compare with manufacturer's specifications.

(a) If the cam does not operate properly, install the pressure gauge in the bottom of the end plate.

103

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(b) Turn the regulating valve spring adjusting plug to obtain correct pressure.		
(c) Pump housing pressure test.		
1. Remove the pump timing plate from the pump.		
2. Install the compound pressure gauge, 4068 gauge block and the 4077 flange, to the side of the side of the pump.		
3. Operate engine at both low and high idle.		
4. 6 to 8 PSI should be maintained in the pump.		
f. Nozzle test.		
(1) Disconnect fuel line at nozzle.		
(2) Connect Kiene test pump using connector nut 4014 and 4021 Ermeto adapter to nozzle and connector nut 4012 to test pump.		
(3) Select proper gauge for the test pump in accordance with nozzle opening pressure.		
(4) Operate test pump and record opening pressure to nozzle.	f.(4) Take class to shop and demonstrate Roosa Master fuel pump service.	f.(4) Follow demonstration while referring to job sheet.

104

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
f.(4) Direct and supervise student practice in tune-up of International Diesel engine.	f.(4) Practice tune-up of International Diesel engine while complying with manufacturers' specifications as specifie in job sheet.

E. GM Diesel Engine Tune-Up.

1. Valve admustment.

a. 6V engines.

(1) Engine at normal operating temperature (160° - 185° F.).

(a) Allow an additional .002" clearance when setting valves cold.

(2) Governor stop lever in the no fuel position.

(3) Remove valve cover.

(4) Position engine.

(a) Rotate the crankshaft until the injector follower is fully depressed on the cylinder to be adjusted.

CAUTION: When using a wrench on the crankshaft bolt at the front of the engine, do not turn the crankshaft in a left-hand direction of rotation as the bolt will be loosened.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(5) Check valve clearance (normal operating temperature).

(a) Use .013" - GO - .015" NO GO Method.

(6) Adjust valve clearance (cold).

(a) Loosen the push rod lock nut.

(b) Place a .017" feeler gauge between the valve bridge and the valve rocker arm pallet.

(c) Adjust the push rod to obtain a smooth pull on feeler gauge.

(d) Remove feeler gauge hold the push rod with a 5/16" wrench and tighten the lock nut with a 1/2" wrench.

(e) Recheck the clearance. If the adjustment is correct. the .015" feeler gauge will pass freely between the valve bridge and valve rocker arm pallet. But the .017" feeler gauge will not pass through.

(7) Adjust remaining valves in firing order.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
NOTE: SAFETY PRECAUTION: When a push rod has been disconnected from the rocker arm cleavis, the push rod must be screwed back into the clevis until it is flush with the threaded portion of the clevis before the rocker arm is bolted back in place. Failure to do so may permit the piston to hit the head of the valve when the engine is turned over.	Issue job sheet and take class to shop and demonstrate valve adjustment procedure for GM 6V-71 engines.	Observe demonstration following job sheet.
b. In-Line Engines.		
(1) Engine at normal operating temperature (160° - 185° F.).		
(a) Allow an additional .002" clearance when setting valves cold.		
(2) Place governor throttle control lever in the NO FUEL position.		
(3) Rotate the crankshaft until the injector follower is fully depressed on the cylinder to be adjusted.		
(4) Adjust valve clearance (cold).		
(a) Loosen push rod lock nut.		
(b) Place a .013" feeler gauge between the valve stem and the rocker arm.		
(c) Adjust the push rod to obtain a smooth pull on the feeler gauge.		

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(d) Remove feeler gauge, hold the push rod with a 5/16" wrench and tighten the lock nut with a 1/2" wrench.

(e) Recheck the clearance. If the adjustment is correct the .011" feeler gauge will pass freely between valve stem and rocker arm, but the .013" feeler gauge will not pass through.

(5) Adjust remaining valves in firing order.

2. Injector timing (In-Line and 6V engine).

a. Use proper timing tool.

(1) 1.460" - for S-70 and HV? injectors
1.484" - HV6 injectors

b. Governor stop lever in NO FUEL position.

c. Position engine.

(1) Valves fully open on cylinder to be adjusted.

d. Check timing dimensions.

(1) Distance from top of body to top of follower.

112 (2) Timing tool in hole on top of body.

113

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(a) Insure that there is not dirt in hole prior to inserting tools.

(3) Hold tool perpendicular to body.

(a) The flat of the gauge toward the injector follower.

(4) Extend portion of gauge should just clear the top of followers.

(a) Follwer too low - early injection.

e. Adjust follower height.

(1) Screwing push rod into clevice will permit followers to rise.

f. Time remaining injectors in firing order.

3. Governor gap adjustment (In-Line and 6V engine).

a. To ensure that all the governor spring tension is being imparted to the weights through the lever and not to the housing.

b. Remove the governor cover.

c. Place the speed control lever in the maximum speed position.

d. Measure gap between governor spring plunger and plunger guide.

(1) In-Line engines.

(a) V.S. .006".

(b) SWLS -- .170".

(c) DWLS -- .0015".

e. Adjust gap.

(1) Loosen the lock nut and turn the adjusting screw until a slight drag is noted on the feeler gauge.

f. Hold the adjusting screw and tighten the lock nut.

g. Install the governor cover.

NOTE: Insure that pin on governor control lever shaft sets into slot on differential lever when replacing cover.

4. Equalizing racks.

a. 6V engines.

NOTE: Position injection rack control levers with the throttle in the full fuel position.

NOTE: The letters "R" and "L" indicate the injector location in the right or left cylinder bank, viewed from the rear of the engine. Adjust the No. 1L injector rack control lever first to establish a guide for adjusting the remaining left bank control levers.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(1) Disconnect any linkage attached to the governor stop lever.

(2) Loosen all of the inner and outer injector rack control lever adjusting screws on both cylinder heads and both load limit device adjusting screws.

NOTE: Be sure all injector rack control levers are "free" on the injector control tubes.

(4) Check for binding in the governor to control tube linkage by moving the linkage through it's full range of travel with one hand on the stop lever and the other hand on one of the control tube levers.

(5) Remove the clevis pin from the fuel rod at the right cylinder bank injector control tube lever.

(6) Move the speed control lever to the MAXIMUM SPEED position.

(7) Move the governor stop lever to the "RUN" position and hold it in that position with light finger pressure.

(8) Turn the inner adjusting screw of the No. 1L injector rack control lever down until a slight movement in the governor stop lever is noted.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(9) Screw outer screw in until it bottoms lightly on the injector control tube.

(a) Tighten inner and outer screws alternately.

(10) Move the governor stop lever back and forth a few times and note a "rotating" movement of the injector control rack when the stop lever is moved to the "RUN" position.

(11) Hold the stop lever in the "RUN" position and using a screw driver press downward on the injector control rack.

(a) Rack should tilt downward and when the pressure of the screw driver is released, the control rack should "spring" back upward.

(b) Adjust the inner and outer adjusting screws to obtain this condition.

(c) At this point, No. 1L injector rack control lever is fully adjusted.

(d) Tighten both the inner and outer adjusting screws and recheck adjustment.

(12) Remove clevis pin from fuel rod at the right cylinder bank injector control tube lever.

120

121

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(13) Insert the clevis pin the fuel rod on the right cylinder bank injector control tube lever.

(a) Adjust No. 1R injector rack the same way you adjusted No. 1L.

(14) Adjust the remaining injector rack control levers.

(a) Remove clevis pin from the fuel rods and the injector control tube levers.

(b) Hold injector control racks in the full-fuel position.

(c) Turn down the inner adjusting screw of the injector rack control lever until the screw bottoms (injector control rack in the full-fuel position).

(d) Turn down outer adjusting screw of the injector rack control lever until it bottoms on the injector control tube.

(e) While still holding control tube lever in the full-fuel position. Adjust the inner and outer adjusting screws to obtain the same condition as outlined in step (11).

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
CAUTION: Once No. 1L and No. 1R injector rack control levers are adjusted do not try to alter their settings.		
(15) When all injector rack control levers are adjusted recheck their settings.	a.(15) Take class to shop and demonstrate injector timing and rack equalization procedures.	a.(15) Observe demonstration and follow procedures outlined in job sheets.
(16) Insert the clevis pin in the fuel rods and the injector control tube levers.		
b. In-Line engines.		
(1) Disconnect any linkage attached to the governor stop lever.		
(2) Back out the buffer screw 5/8".		
(3) Loosen all of the inner and outer injector rack control lever adjusting screws.		
NOTE: Be sure all injector rack control levers are "free" on the injector control tubes.		
(4) Move speed control lever to MAXIMUM SPEED position.		
(5) Move the governor stop lever to the "Run" position and hold it that position with light finger pressure.		
(6) Turn the inner adjusting screw of the No. 1 injector rack control lever down until a slight movement in the governor stop lever is noted.		

124

125

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(7) Screw outer screw in until it bottoms lightly on the injector control tube.

(a) Tighten inner and outer screws alternately.

(8) Move the governor stop lever back and forth a few times and note a "rotating" movement of the injector control rack when the stop lever is moved to the "Run" position.

(9) Hold the stop lever in the "Run" position and using a screw driver press downward on the injector control rack.

(a) Rack should tilt downward and when the pressure of the screw driver is released, the control rack should "spring" back upward.

(b) Adjust the inner and outer adjusting screws to obtain this condition.

(c) At this point, No. 1 injector rack control lever is fully adjusted.

(d) Tighten both the inner and outer adjusting screws and recheck adjustment.

(10) Adjust the remaining injector rack control levers.

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

(a) Remove clevis pin from the fuel rods and the injector control tube levers.

(b) Hold injector control racks in the full-fuel position.

(c) Turn down the inner adjusting screw of the No. 2 injector rack control lever until the screw bottoms (injector control rack in the full-fuel position).

(d) Turn down outer adjusting screw of the injector rack control lever until it bottoms on the injector control tube.

(e) While still holding control tube lever in the full-fuel position. Adjust the inner and outer adjusting screws to obtain the same condition as outlined in step (9).

CAUTION: Once No. 1 injector rack control lever is adjusted do not try to alter this setting.

(11) When all injector rack control levers are adjusted recheck their settings.

(12) Insert the clevis pin in the fuel rod and the injector control tube lever.

128

129

OUTLINE OF INSTRUCTION | INSTRUCTOR ACTIVITY | STUDENT ACTIVITY

5. Idle and buffer spring adjustment.

   a. Start engine and run until warm.

      (1) Stop lever in run position.

      (2) Speed control lever in idle position.

   b. Adjust idle speed screw.

      (1) Loosen lock nut and turn idle speed screw until engine idles at recommended idle speed.

   c. Adjust buffer screw.

      (1) Engine at idle speed.

      (2) Turn buffer screw "IN" so that it contacts differential lever as lightly as possible and still eliminates engine roll.

      (3) Hold buffer screw and tighten lock nut.

NOTE: Do not raise engine idle speed more than 15 rpm with the buffer screw.

6. Load limit device adjustment (6V engines).

   a. Mechanically limits the travel of the injector racks and thereby the fuel output of the injectors.

   b. The load limiting device is adjusted after the engine tune-up is completed.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(1) Loosen load limit screw lock nut.		
(2) Back load limit screw out of the adjusting screw plate until 1" of the screw is below plate.		
(3) Adjust load linit lever clamp bolts so the lever is free to turn on the injector rack control tube.		
(4) Loosen load limit lever clamp bolts so the lever is free to turn on the injector rack control tube.		
(5) Thread the load limit screw into the adjusting screw plate until the lock nut "bottoms" against the top of the plate.		
(6) Hold injector rack control tube in the full-fuel position and place the load limit lever, against the bottom of the load limit screw. Then tighten the load limit lever clamp bolts.		
(7) Check to ensure that the injector racks will just go into the full-fuel position.	b.(7) Take class to shop and demonstrate load limit adjustment.	b.(7) Observe demonstration and follow job sheet procedures.
(8) Hold load limit screw to keep it from turning, then set the lock nut until the distance between the bottom of the lock nut and top of the adjusting screw plate.		

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
(a) Corresponds to the marking on the adjusting screw plate.		
(9) Thread load limit screw into the plate until the lock nut "bottoms" against the top of the plate.		
(10) Hold load limit screw to keep it from turning, then tighten the lock nut to secure the setting.		
7. Fuel flow test.		
a. Disconnect return line to tank.		
b. Operate engine at 1,200 rpm and measure amount of fuel flow into a container for one minute.		
(1) 0.8 gallong of fuel per minute (6V engine).		
(2) 0.5 gallon of fuel per minute (In-Line engine).		
c. Immerse tube in fuel and watch for air bubbles.		
(1) Indicates leakage on suction side of pump.		
(a) Filters, gaskets and lines.	Redemonstrate any procedures not completely clear to class using student assistance where needed.	Observe demonstrati following steps out- lined in job sheet participating in pr dures as called on instructor.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
Direct and supervise, student practice in tune-up of GM 6V-71 diesel engine.	Practice tunepup of 6V-71 diesel engines while complying with manufacturer's specifications as outline in the job sheet.
III. Direct, supervise and evaluate student performance in conducting diesel engine tune-up.	III. Tune-up diesel engines using appropriate tools and procedures as specified by the manufacturer's without deviation as stated in the job sheet.

III. Application:

A. Students perform diesel engine tune-up to restore engine performance to manufacturer's specifications using appropriate tools and procedures specified by the manufacturer's as stated in the job sheet without deviation.

IV. Summary:

A. General checks.

B. Caterpillar engine tune-up procedures.

C. Cummins engine tune-up procedures.

D. Internation engine tune-up procedures.

E. General motors engine tune-up procedures.

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVI
V. Test:	V. Administer test.	V. Take test as directed by instr
A. Knowledge given in this topic will be graded on the basis of a written test student must answer 35 of 50 test items correctly.	V.A. Correct tests and evaluate results. Review missed test item with class	V.A. Participate class discussion missed test items
B. Student will be examined on the practical aspects of this topic by tuning diesel engines to comply with manufacturer's specifications without deviation.		
VI. Assignment: None.		

NAVAL CONSTRUCTION TRAINING CENTER
PORT HUENEME, CALIFORNIA 93043
SPECIAL CONSTRUCTION BATTALION TRAINING COURSE (SCBT) 334.2

JOB SHEET

TITLE: Diesel Engine Tune-Up, Cummins with P.T. Fuel System

INTRODUCTION: The purpose of this job sheet is to guide you in the practical performance of restoring engine performance of a Cummins diesel engine with P.T. Fuel System to a specific level as required by the manufacturer. Each student will use the required hand and special tools for making valve adjustments, setting injectors, and using specific test equipment to trouble-shoot a Cummins P.T. pump. Corrective adjustments will be made in accordance with the job sheet, the instructor will inspect procedures to determine job errors, safety procedures and proper sequence of events before proceding to the next procedure.

TOOLS AND EQUIPMENT:

1. Diesel engine shop hand tools.
2. Cleaning solvent.
3. Wiping rags.
4. Diesel fuel.
5. Cummins special tools.
6. Torque wrench.
7. Thickness gauge.

CONDITIONS:

1. Each student will be assigned to a Cummins engine to accomplish test and tune-up procedures.
2. Each student will be provided with all the required tools, manuals and job sheets.
3. Preceeding the shop performance all aspects of the job with necessary background data will be covered in an actual shop demonstration by the instructor.

PROCEDURES:

1. General checks.

   a. Remove and inspect air cleaner.

   b. Inspect related air system piping.

   c. Inspect turbocharger and manifold piping.

   d. Check external fuel system components.

   e. Check "V" belt drivers.

   f. Check batteries.

STOP: Instructor Check Point _____

   g. Prestart check engine in preparation for starting engine.

   h. Start engine and run until normal temperature is reached. Stop engine.

   i. Remove hood if applicable.

   j. Remove valve cover.

   k. Rotate engine until the first "VS" mark on the pulley or damper is aligned with the index mark on the housing.

STOP: Instructor Check Point _____

   l. Loosen lock nut on injector push rod.

   m. Using a good torque wrench with screw driver adapter, draw the injector adjusting screw tight, then loosen.

   n. Set the torque wrench dial to 48 inch/pounds and then turn the screw tight until the torque wrench hand comes to zero.

NOTE: This sequence should be done in near continuous motion to achieve accurate adjustment of the injector plunger.

   o. Tighten lock nut.

STOP: Instructor Check Point _____

NOTE: If the engine is equipped with a valve cross head, cross head adjustment must be made prior to valve adjustment.

p. Loosen the adjusting screw lock nut and back off the adjusting screw one turn.

q. Use light finger pressure at the rocker lever contact surface with the valve stem nearest the push rod.

r. Turn adjusting screw down until it contacts it's mating valve stem.

s. Hold the adjusting screw in this position and tighten lock nut to specified torque.

STOP: Instructor Check Point _____

t. Loosen rocker arm lock nuts.

u. Using a specified thickness gauge turn the adjusting screw to obtain a good contact on the thickness gauge.

v. Set both the intake and exhaust valves.

w. Tighten lock nuts.

x. Bar engine over in direction of rotation and firing order and set the rest of the injectors, crossheads and valves.

STOP: Instructor Check Point _____

y. Install valve covers.

z. Remove fuel pump filter screens.

aa. Clean screens.

bb. Reinstall and torque to specified limits.

cc. Attach tachometer to the drive outlet on top of the fuel pump.

dd. Remove pipe plug from spring pack cover.

ee. Set engine idle to manufacturer's specifications.

ff. Replace pipe plug.

NOTE: Engine idle speed changes when the housing fills with fuel.

STOP: Intructor Check Point _____

gg. Check high idle using tachometer connected to the drive outlet on top of the fuel pumps.

NOTE: If high idle has to be changed, shims will either have to be added or removed from beneath the governor high-speed spring and the high-speed spring retainer.

hh. Shut engine down.

ii. Remove 1/8" pipe plug from the side of the fuel shut-off valve.

jj. Install ST-435 pressure gauge.

STOP: Instructor Check Point _____

kk. Start engine.

ll. Snap the throttle fully open two or three times and carefully watch the gauge.

mm. Screw rear screw outward until pressure increase stops.

nn. Turn screw inward until pressure drops 3 to 5 PSI.

STOP: Instructor Check Point _____

oo. Lock screw in place.

NOTE: Refer to specification sheet for the engine model. Keep in mind that snap fuel pressure readings are 3 to 5 PSI higher than a steady reading would be under load.

pp. Run engine at idle speed.

qq. Screw forward throttle screw inward until engine begins gaining speed.

rr. Back out screw two turns and lock.

ss. Remove spring pack cover plug and adjust governor screw.

(1) 5 - 10 RPM below idle speed.

tt. Replace plug and run engine until all air is purged from system.

STOP: Instructor Check Point _____

uu. Install ST-435 gauge at the shut-off valve.

vv. Operate engine 400 RPM below governor speed.

ww. Accelerate to governed speed.

(1) Observe gauge for specified pressure.

(2) Maximum pressure is adjusted by removing or installing shims in pressure regulating valve.

STOP: Instructor Check Point _____

xx. Install the ST-435 vacuum gauge at gear pump inlet.

yy. Operate engine for 5 minutes to purge air from system.

zz. Observe gauge reading, should not exceed 8 to 8.5" vacuum.

STOP: Instructor Check Point _____

AA. Shut down engine.

BB. Install sight gauge on pumps inlet side and operate engine.

CC. Check for air bubbles.

NAVAL CONSTRUCTION TRAINING CENTER
PORT HUENEME, CALIFORNIA 93043
SPECIAL CONSTRUCTION BATTALION TRAINING COURSE (SCBT) 334.2

JOB SHEET

TITLE: Diesel Engine Tune-Up, International with Roosa Master Fuel System

INTRODUCTION: The purpose of this job sheet is to guide you in the practical performance of restoring engine performance of a International Diesel Engine with Roosa Master Fuel Injection Pump to a specific level as required by the manufacturer. Each student will use the required hand and special tools for making valve adjustments, setting injectors or replacing nozzles if required by the instructor. Install specific test equipment, record and analyze readings, and make corrective adjustments as required bh the job sheet and the manufacturer's manual. At designated points on the job sheet, the instructor will inspect procedures to determine job errors, safety procedure and proper sequence of events before proceeding to the next procedure.

TOOLS AND EQUIPMENT:

1. Diesel engine shop hand tools.
2. Cleaning solvent.
3. Wiping rags.
4. Diesel fuel.
5. International and Roosa Master special tools.
6. Torque wrench.
7. Thickness guages.

CONDITIONS:

1. Each student will be assigned to an International engine with Roosa Master Fuel System to accomplish test and tune-up procedures.
2. Each student will be provided with all required tools, manuals and job sheets.
3. Preceeding the shop performance all aspects of the job with necessary background data will be covered in an actual shop demonstration by the instructor.

PROCEDURES:

1. General checks.

   a. Remove and inspect air cleaner.

   b. Inspect related air system piping.

   c. Inspect turbocharger and manifold piping.

   d. Check external fuel system components.

   e. Check V belt drivers.

   f. Check batteries.

STOP: Instructor Check Point _____

   g. Prestart check engine in preparation for starting.

   h. Start engine and run until normal temperature is reached. Stop engine.

   i. Remove hood if applicable.

   j. Remove valve cover.

   k. Rotate crankshaft until number one (1) piston is on the compression stroke.

NOTE: The timing pointer on the front cover will be in line with T.D.C. mark on the vibration damper.

STOP: Instructor Check Point _____

   l. Loosen rocker arm lock nuts.

   m. Use a feeler gauge of a specified thickness and turn the rocker arm adjusting screw in or out, until the correct feeler gauge clearance is obtained.

   n. Set both intake and exhaust valves.

NOTE: If the engine is equipped with nozzles, proceed to the next cylinder. If the engine is equipped with injectors, injector setting should be made prior to valve adjustment (injector setting).

o. Tighten adjusting screw until the plunger just bottoms.

p. Loosen the adjusting screw 1/2 turn.

q. Use an inch/pound torque wrench and socket adapter D-1280 and tighten the adjusting screw to 35 inch/pounds cold setting.

STOP: Instructor Check Point _____

r. Install valve ccvers.

s. Disconnect throttle linkage.

t. Using a tachometer, adjust the high idle stop screw until the specified high idle speed is obtained.

u. Shut down engine.

v. Install the compound gauge assembly (tool no. 407) in the pressure trap of the transfer pump.

STOP: Instructor Check Point _____

w. Operate engine at high idle.

x. Record the reading and compare to manufacturer's specifications.

STOP: Instructor Check Point _____

y. Remove the compound gauge assembly.

z. Install the compound gauge assembly in the inlet fitting of the transfer pump.

STOP: Instructor Check Point _____

aa. Operate engine at high idle.

bb. Record the reading and compare to manufacturer's specifications.

NOTE: If the checks shows the transfer pumps and pressure regulating valve to be in a serviceable condition. Required supply pressure may be achieved by adjusting the pressure regulating valve.

STOP: Instructor Check Point _____

cc. Remove compound pressure gauge.

dd. Use a tackometer and screw the low idle screw either in or out to obtain a low idle speed of 500 to 600 RPM.

ee. Stop engine.

NOTE: If engine is equipped with a model D.C. pumps, speed advance operation has to be checked.

ff. Install the plastic timing window No. 13366 on the pump.

gg. Align the following timing marks.

(1) Timing line on the governor weight retainer with the cam timing line.

(2) Alignment of the timing marks on the vibration damper and the front case.

STOP: Instructor Check Point _____

NOTE: If the timing marks do not align remove and reinstall the pump in accordance with manufacturer's procedures.

hh. Start engine and observe the cam line from idle to high idle. Observe and record number of degrees of cam movement.

STOP: Instructor Check Point _____

NOTE: If the cam does not operate properly install the pressure gauge in the bottom of the end plate.

ii. Turn the regulating valve spring adjusting plug to obtain the correct pressure as specified by the manufacturer.

STOP: Instructor Check Point _____

jj. Remove the pumps timing plate from the pumps.

kk. Install the compound pressure gauge, 4068 gauge block, and the 4072 and 4077 flange to the side of the pump.

ll. Operate the engine at both low and high idle.

mm. Record the reading and compare to manufacturer's specifications.

STOP: Instructor Check Point _____

nn. Disconnect fuel line at the nozzle.

oo. Connect Kiene test pump using connector nut 4014 and 4021 Ermeto Adapter to nozzle and connector nut 4012 to test pumps.

pp. Select proper gauge for the test pump in accordance with nozzle opening pressure.

STOP: Instructor Check Point _____

qq. Operate test pump and record opening pressure of the nozzle.

NOTE: From the privious tests and analyzing the results, troubles in the Roosa Master Fuel System can be pin-pointed and repaired in a short period of time.

NAVAL CONSTRUCTION TRAINING CENTER
PORT HUENEME, CALIFORNIA 93043
SPECIAL CONSTRUCTION BATTALION TRAINING COURSE (SCBT) 334.2

JOB SHEET

TITLE: Diesel Engine Tune-Up, GM In-Line and V6-71

INTRODUCTION: The purpose of this job sheet is to guide you in the practical performance of restoring engine performance of a GM Diesel Engine to specific level as required by the manufacturer. Each student will use the required hand and special tools for making valve adjustments, injector timing, rack equalization and replacement of specified components, following procedures given in this job sheet and complying with manufacturer's specifications without deviation at designated points in the job sheet, the instructor will inspect procedures to determine job errors, safety procedures and proper sequence of events before proceeding to the next procedure.

TOOLS AND EQUIPMENT:

1. Diesel engine shop hand tools.
2. Cleaning solvent.
3. Wiping rags.
4. Diesel fuel.
5. GM diesel special tune up tools.
6. Torque wrench.
7. Thickness gauge.

CONDITIONS:

1. Each student will be assigned to various GM Diesel Engines to accomplish test and tune-up procedures.
2. Each student will be provided with all the required tools, manuals and job sheets.
3. Preceding the shop performance all aspects of the job with necessary background data will be covered in actual shop demonstrations by the instructor.

PROCEDURES:

1. GM V6-71 Diesel Engine Tune-Up.

   a. Prestart check engine, start and bring engine temperature up to operating range.

   b. Remove valve cover.

   c. Rotate crankshaft until the injector follower is fully depressed on the cylinder to be adjusted.

NOTE: When using a wrench in the crankshaft bolt on the front of the engine, do not turn the crankshaft in a LEFT hand direction of rotation as the bolt will be loosened.

   d. Loosen push rod lock nut.

   e. Insert a feeler gauge of a predetermined thickness between the rocker arm and the end of the valve.

NOTE: If equipped with a valve bridge, insert feeler gauge between the rocker arm and the valve bridge.

   f. Rotate the engine in the direction of travel and set the remaining valves in accordance with the firing order.

STOP: Instructor Check Point _____

   g. Rotate engine until the exhaust valves on a specified cylinder are fully open.

   h. Using the proper timing tool.

      (1) 1.460 for S-70 and HV-7 injection.

      (2) 1.484 for HV-6 injector.

   i. Insert timing tool in the hole on top of the injector body.

   j. Hold the tool perpendicular to body, slowly rotate the tools so the extended portion of the gauge just clears the top of the follower.

   k. Time the remaining injectors in firing order.

STOP: Instructor Check Point _____

l. Remove the governor cover.

m. Place the speed control lever in the maximum speed position.

n. Measure the gap between governor spring plunger and plunger guide.

o. Set to manufacturer's specifications.

STOP: Instructor Check Point _____

p. Install the governor cover.

NOTE: Position injection rack control levers with the throttle in the full-fuel position.

NOTE: The letters "R" and "L" indicate injector locations in the RIGHT or LEFT cylinder bank, viewed from the rear of the engine. Adjust the No. 1L injector rack control lever first.

q. Disconnect any linkage attached to governor stop lever.

r. Back out buffer screw 5/8".

s. Loosen all of the inner and outer injector rack control lever adjusting screws on both cylinder heads and both load limiting device adjusting screws.

NOTE: Be sure all injector rack control levers are free on the injector tubes.

STOP: Instructor Check Point _____

t. Remove the clevis pin from the fuel rod at the RIGHT cylinder bank injector control tube lever.

u. Move the speed control lever to the maximum speed position.

v. Move the governor stop lever to the "RUN" position and hold it in that position with light finger pressure.

w. Turn the inner adjusting screw of No. 1L injector rack control lever down until a slight movement in the governor stop lever is noted.

x. Screw the outer screw "IN" until it bottoms lightly on the injector control tube.

(1) Tighten inner and outer screws alternately.

y. Hold the stop lever in the "RUN" position and using a screw driver press downward on the injector control rack. Rack should tilt downward, release screw driver pressure, the control rack should spring backward.

STOP: Instructor Check Point _____

z. Adjust the remaining racks on the left bank.

aa. Remove the clevis pin from the fuel rod at the LEFT bank injector control tube lever.

bb. Insert the clevis pin in the fuel rod on the RIGHT cylinder bank injector control tube lever.

STOP: Instructor Check Point _____

cc. Adjust the RIGHTSIDE in the same manner as the LEFTSIDE, use steps v to aa.

NOTE: The procedure for equalizing racks on in-line engines is identical to equalizing one bank on a "V" type engine.

dd. Reconnect all linkage.

STOP: Instructor Check Point _____

ee. Start and operate engine until warm.

ff. Loosen lock nut and turn idle speed screw until engine idles at recommended idle speed.

gg. Hold idle speed screw and tighten lock nut.

hh. Turn buffer screw IN so that it contacts the differential lever as lightly as possible and still eliminates engine roll.

ii. Hold buffer screw and tighten lock nut.

NOTE: Do not raise engine idle speed more than 15 RPM with the buffer screw.

STOP: Instructor Check Point _____

jj. If equipped with a load limiter, loosen load limit screw lock nut.

kk. Adjust load limit screw lock nut so the bottom of the lock nut is 1-3/4" from the bottom of the load limit screw.

ll. Tighten lock nuts.

mm. Disconnect return fuel line to tank.

nn. Operate engine at 1,200 RPM and measure amount of fuel into a container for one minute. Compare to manufacturer's specifications.